

Psychological Evaluation of the Effect of Exposure to Projector Light while Viewing Art

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ABSTRACT

When projecting art and other contents using a projector, entering the space where the contents are projected is considered adequate. The purpose of this study is to confirm the effectiveness of this method through a psychological experiment. We constructed a space in our laboratory where art can be projected and viewed. Then we asked subjects to view art contents under three viewing conditions (Condition 1: Outside the projection space, sitting on a chair; Condition 2: Inside the space, sitting on a chair; Condition 3: Inside the space, sitting on a floor), and to evaluate the experience in terms of "Impression," "Relaxation," "Motivation," and "Creativity." As a result, Condition 2 was rated higher than the other conditions in "Relaxation," partially confirming the effect of entering the projection space to view the art. At the same time, there was little difference among the conditions for "Impression," "Motivation," and "Creativity." Therefore, further experiments will be conducted to clarify the effects of entering the projection space and viewing art content.

Keywords: Projector, Art Appreciation, Media Art, Exposure to Projector Light, Psychological Evaluation.

1. INTRODUCTION

A form of art exhibition displaying art videos or images using a projector is becoming increasingly popular. Projection mapping, for example, is widely accepted because it can artistically transform an entire environment by projecting contents onto an existing three-dimensional object, such as a building [1][2].

Another exhibition format is one in which artwork is projected onto the entire space, including the floor and the viewer entering the space. The conventional exhibition format is to view the artwork from a third-party perspective, and this entering the space was often avoided because it would result in a portion of the content being projected onto the viewer's body or the viewer's shadow being displayed. Recently, however, this type of exhibition format is often used.

This form of viewing is becoming increasingly popular because the viewer is exposed to the light from the projector. A portion of the content is projected onto his or her body, giving the viewer a sense of being one with the content. For example, exhibits in Invisible World at the NY Museum of Natural History [3] and the Teamlab exhibit [4] use an exhibition format in which the viewer is exposed to light from a projector, and a portion of the

content is projected onto the viewer's body. Figure 1 shows a view of the exhibit at the NY Museum of Natural History.



Fig. 1. Exhibit in the Invisible World at the New York Museum of Natural History.
(<https://www.amnh.org/exhibitions/invisible-worlds>)

However, experiments have yet to be conducted to confirm this. With the above background, this research evaluates, through a psychological experiment, how exposure to light and the projection of art content on the body psychologically impacts the viewer when viewing an artwork such as video art.

2. RELATED RESEARCH

It is well known that art has a significant influence on human psychology. Many studies have been conducted on the relationship between visual art (e.g., paintings), auditory art (e.g., music), and psychology [5]. It has been reported that visiting art museums and viewing paintings lowers blood pressure and reduces stress [6]. Art appreciation is also reported to be effective in preventing and recovering from dementia [7]. Using this, a project to prevent or alleviate dementia by having patients with dementia systematically visit art museums has been conducted [8]. Furthermore, it has been reported that art appreciation and being involved in art production effectively treat cancer and other diseases [9].

However, the art in these studies is conventional fine art, such as paintings, and there have been few evaluation studies using recent art, such as video art. In particular, when the space in which art is projected is configured using projectors, how the relationship between the projection space and the viewer affects the viewer is an important issue. However, it is still considered to be an unexplored research field.

3. METHODS OF PSYCHOLOGICAL EVALUATION EXPERIMENT

3.1 Subjects

This experiment was conducted with 27 Kyoto University students.

3.2 Experimental environment

Art content is projected by a projector under the following two defined setting conditions, and subjects are asked to evaluate the art content subjectively. The concepts are shown in Fig. 2. On the right side of Fig. 2, art contents are projected onto a floor surface by a projector, viewed by a viewer from outside the projection space. On the left side, the viewer enters the projection space and is exposed to the projector's light while viewing a portion of the projected content onto his or her body.

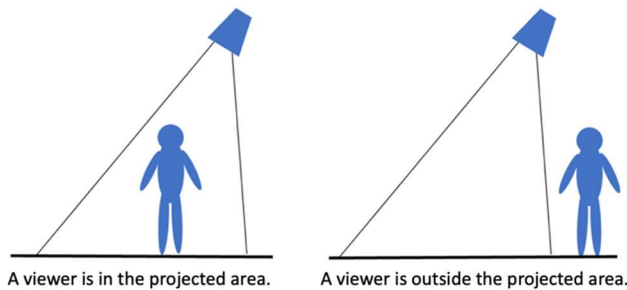


Fig. 2. Conceptual diagram of the experimental environment.

3.3 Actual experimental environment

For the projector model, an ultra-short-focus projector (EPSON EB-770F/4100lm) was used to obtain a sufficient projection area because the ceiling height was not high enough. The actual experimental environment is shown in Fig. 3.



Fig. 3. Actual experimental environment (Left: projector and installation frame; Right: projector and projection surface viewed from behind)

Preliminary experiments showed that the projector's installation height (approximately 2m) was insufficient. Therefore, it was found that, to be sufficiently illuminated or projected the content onto one's body, the viewer must sit in a chair or on the floor to view the art. Based on this preliminary experiment, we decided to have the subjects view the art under the following three conditions in the actual experiment.

Condition 1 (Out/Chair): Subjects sit on a chair outside the projection space.

Condition 2 (In/Chair): Subjects sit in the projection space on a chair.

Condition 3 (In/Floor): Subjects sit on the floor in the projection space.

Figure 4 shows how subjects viewed the art images in the three experimental conditions.

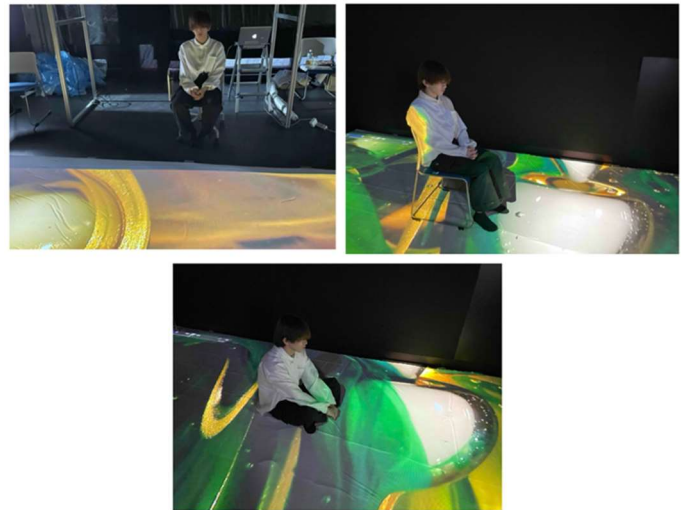


Fig. 4. Actual art viewing. Top left: Condition 1, Top right: Condition 2, Bottom middle: Condition 3.

3.4 Contents

The projection's art content is the video artwork "Genesis [10]" created by Naoko Tosa, one of the authors. The reasons for using this artwork are as follows.

(1) Genesis is a work in which various color paints are injected into a liquid (viscous water) containing dry ice. The paint, which is trying to diffuse, interacts with the dry ice bubbles rising upward, photographed with a high-speed camera, creating various shapes. Compared to a painting created with a paintbrush, this is a natural phenomenon that does not involve human manipulation, thus eliminating arbitrariness on the artist's part.

(2) Genesis has various works depending on the paint color used. Since they have similar characteristics but give slightly different impressions, they can be used to eliminate the adverse effects of repeatedly using the same content in psychological evaluation experiments. Repeating the experiment multiple times with the same subject under different setting conditions is common in psychological experiments. If the same content is used in such experiments, the subject's degree of concentration may decrease due to familiarity with the content, which may affect the results. Using several different contents based on the same production

method and with the same characteristics but using different colors, such as in Genesis, can eliminate such adverse effects.

3.5 Evaluation Items

Twenty-four evaluation items, grouped into "Impression factor," "Relaxation factor," "Motivation factor," and "Creativity factor," were used (Table 1). A psychology expert, one of the authors, determined and validated these questionnaire items [11].

Table 1. Evaluation Items.

Impression factor	Motivation factor
Comfortable - Uncomfortable	Enthusiastic - Not Enthusiastic
Friendly - Unfriendly	Immersed - Not immersed
Beautiful - Not beautiful	Curious - Not curious
Calm - Restless	Motivated - Not motivated
Interesting - Boring	Aroused - Not aroused
Warm - Cold	Creativity Factor:
Changeable – Not changeable	Associate - Do not associate
Luxury - Sober	Immersive - Not immersive
Individual - Ordinary	Activated - Not activated
Relaxation factor	Inspired - Not Inspired
At ease - Not at ease	In the zone - Not in the zone
Secure – Not secure	
Pleasant - Not pleasant	
Relaxed – Not relaxed	
Healed - Not healed	

The evaluation was on a 7-point scale from 1 to 7, and the evaluation results were entered using Google Forms using each subject's smartphone.

3.6 Actual experimental conditions

As previously described, the subjects have three conditions: Condition 1 (Out/Chair), Condition 2 (In/Chair), and Condition 3 (In/Floor). The three types of art content to be used are as follows.

- Content 1:** Genesis Red
- Content 2:** Genesis Blue
- Content 3:** Genesis Green

The three conditions of the subjects and three types of art content are combined according to a design-of-experiment method, and three experiments are conducted for each subject.

3.7 Experimental process

Figure 5 shows the actual experimental process.

Explanation (5 mins)	Viewing 1 (5 mins)	Evaluation1 (5 mins)	Viewing 2 (5 mins)	Evaluation 2 (5 mins)	Viewing 3 (5 mins)	Evaluation 3 (5 mins)
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Fig. 5. Experimental process.

4. RESULTS OF THE PSYCHOLOGICAL EVALUATION EXPERIMENT

4.1 Comparison of the three experimental conditions

First, the evaluation values of 27 subjects were averaged for the three experimental conditions (Condition 1: Out/Chair, Condition 2: In/Chair, Condition 3: In/Floor) and compared for each evaluation item. Figures 6 (Impression factor), 7 (Relaxation factor), 8 (Motivation factor), and 9 (Creativity factor) show the results.

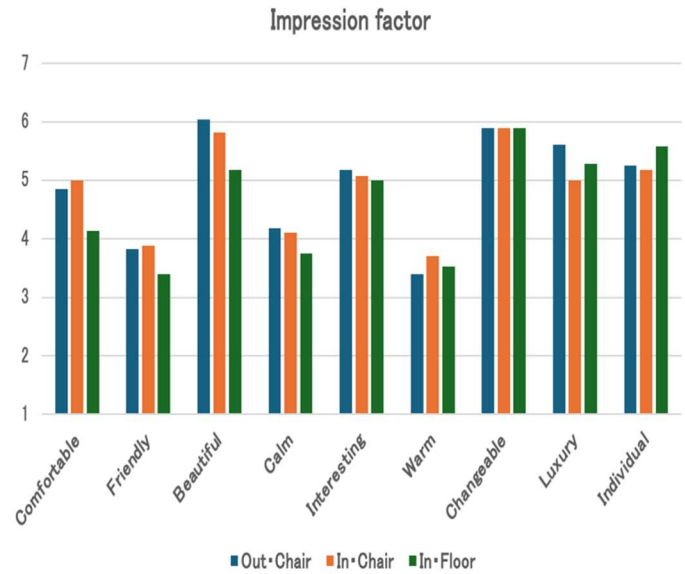


Fig. 6. Results for Impression factor.

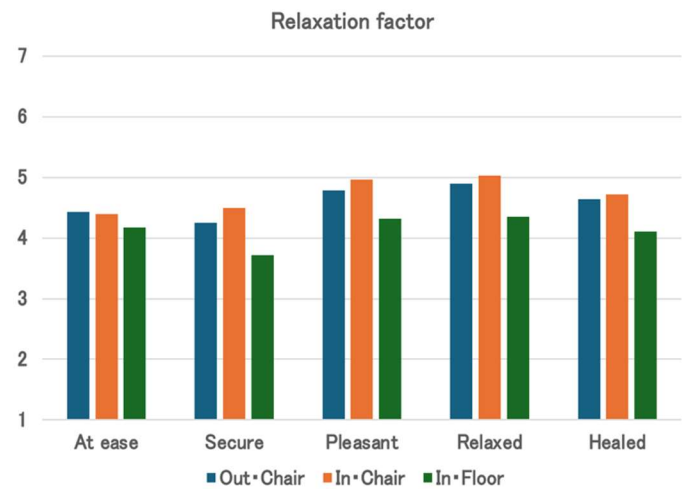


Fig. 7. Results for Relaxation factor.

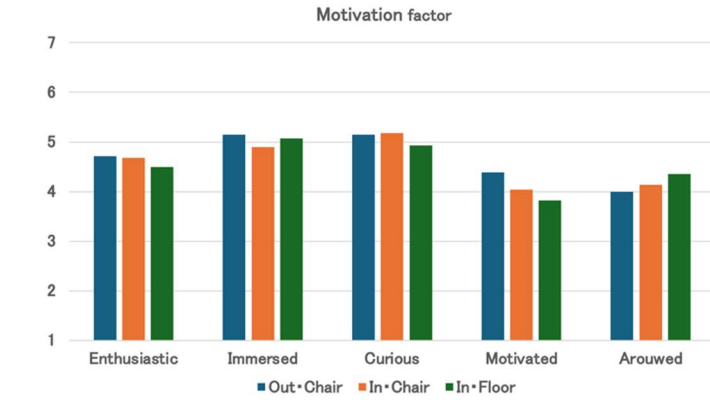


Fig. 8. Results on Motivation factor.

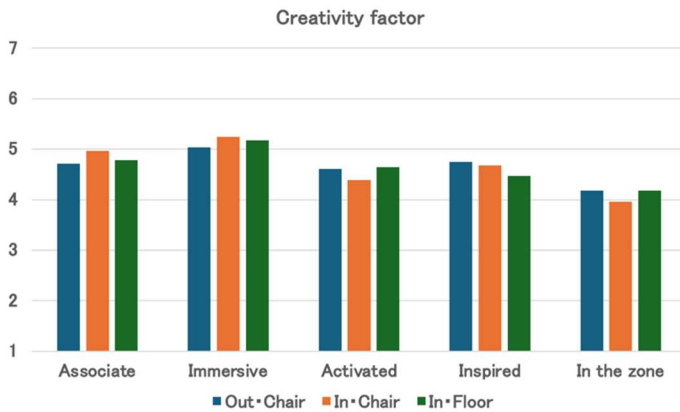


Fig. 9. Results on Creativity factor.

Impression Factor: The differences among the three conditions are not very clear. Looking across the evaluation items, "Beautiful," "Interesting," "Changeable," "Luxury," and "Individual" have high evaluation values of 5 or higher in almost all conditions. On the other hand, "Friendly" and "Warm" have evaluation values of 4 or less, indicating that the content used was not familiar to the subjects.

Relaxation factor: The evaluation values in almost all evaluation items are in the order of In/Chair > Out/Chair > In/Floor, with In/Floor having higher evaluation values than the other conditions. As for the evaluation values, "Relaxed" and "Pleasant" have relatively high values close to 5.

Motivation factor: There are some differences among the evaluation items regarding differences among experimental conditions, but almost all of the items showed little difference among experimental conditions. Regarding evaluation values, "Curious" and "Immersed" have high evaluation values near or above 5.

Creativity factor: The evaluation items differ among experimental conditions, but almost all of the items show little difference. In terms of evaluation values, "Associate" and "Immersive" receive high values near or above 5, followed by "Activated" and "Inspired" at around 4.5 or above.

4.2 Analysis of variance (ANOVA) results

To confirm the discussion above, the results for each factor were analyzed using an analysis of variance (ANOVA). The results are shown in Fig. 10 (Impression factor), Fig. 11 (Relaxation factor), Fig. 12 (Motivation factor), and Fig. 13 (Creativity factor).

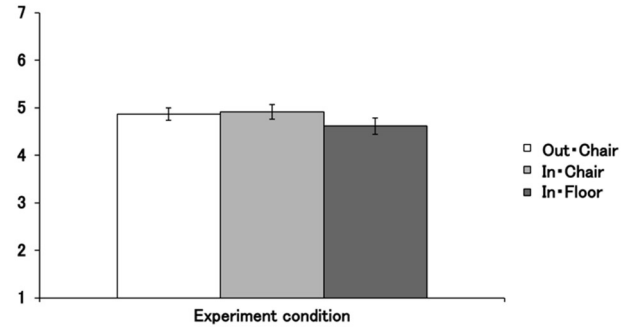


Fig. 10. ANOVA results for Impression factor.

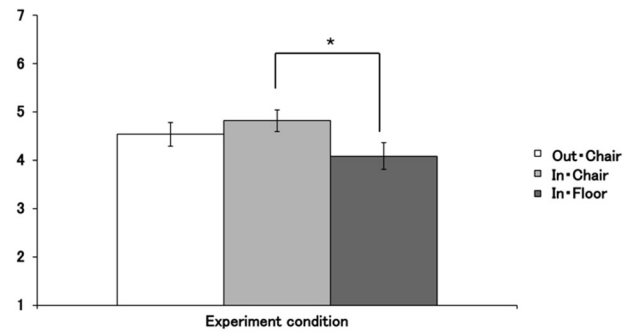


Fig. 11. ANOVA results for Relaxation factor.

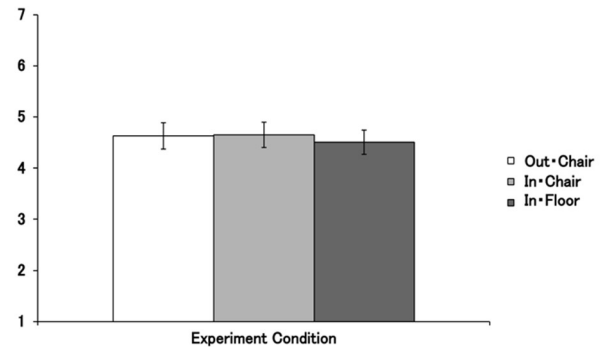


Fig. 12. ANOVA results for Motivation factor.

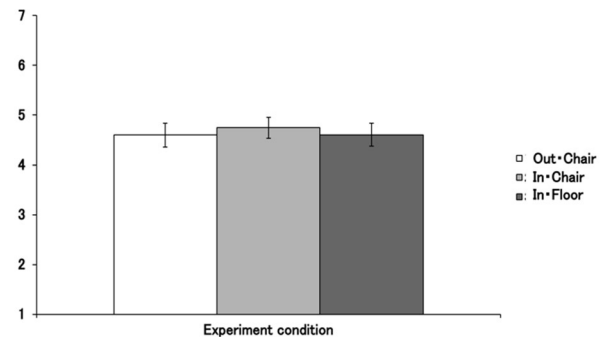


Fig. 13. ANOVA results for Creativity factor.

Impression Factor: The ratings by condition averaged by the evaluation items showed that the "In/Floor" condition had lower rating results than the other conditions. ANOVA results showed that the main effect on experimental conditions was insignificant ($p=.157$).

Relaxation Factor: In the ratings by condition averaged over the evaluation items, "In/Chair" was rated higher than the other conditions. Analysis of variance showed that the main effect related to the experimental condition was significant at the 5% level ($p=.022$). Multiple comparisons revealed that the difference between "In/Chair" and "In/Floor" was significant at the 5% level ($p=.040$).

Motivation Factor: The ratings by condition, averaged by the evaluation items, showed nearly identical scores for all conditions. The main effect on experimental conditions was not significant ($p=.866$).

Creativity Factor: The ratings by condition, averaged by the evaluation items, showed nearly identical scores for all conditions. The main effect on experimental conditions was not significant ($p=.753$).

4.3 Considerations

Relaxation factor results: "In/Chair" was rated higher than "Out/Chair" and "In/Floor" for the relaxation factor. Except for the low value for "In/Floor," the initial goal of "entering the projection space and viewing art under the projector's light" was confirmed to be effective.

However, for the "Impression Factor," "Motivation Factor," and "Creativity Factor," there are few differences between the experimental conditions, and the results of the ANOVA show that the differences among conditions are not significant. Some considerations on this point are discussed below.

Cause of the slight difference between the experimental conditions: In this regard, it is thought that there are advantages and disadvantages to viewing from outside the projection environment and viewing within the viewing environment, respectively. First, the condition of viewing from outside the projection space (Out/Chair) is thought to provide a sensation similar to entering the viewing space since the subject is viewing right next to the projection space, even though outside the projection space. Another advantage is that by viewing from outside the viewing space, one can appreciate the entire space, or in other words, the entire content. On the other hand, viewing from inside the projection space has the advantage of allowing the subjects to experience the sensation of being inside the art space, or in other words, the sensation of being one with the art contents, by being exposed to the light from the projector and the art contents. On the other hand, the disadvantage is that by entering the projection space, the viewer cannot see the entire content from a bird's eye view and can only appreciate a portion. These advantages and disadvantages are thought to complement each other, so the difference between "Out/Chair" and "In/Chair" is not significant.

Reason for the low evaluation of the method of sitting on the floor: Initially, we expected that the "In/Floor" condition, in which visitors sit on the floor, would receive a high evaluation, but as shown in Figs. 10 through 13, the evaluation values were lower than those of the methods in which visitors sit on the chair ("Outside/Chair" and "In/Chair"). This may be because young

people these days are not so accustomed to the posture of sitting on the floor. In future experiments, allowing subjects to freely adopt their preferred posture, such as lying down, will be necessary.

Future Directions: This study partially confirmed the effectiveness of entering the space where art is projected and viewing it. However, we have yet to reach the stage of obtaining sufficient data to demonstrate this. It is necessary to analyze the results of this study in detail regarding the luminance of the projector, the installation conditions of the projector, and the details of the viewing conditions, as well as to consider how to set the conditions for future experiments.

5. CONCLUSION

When using a projector to project art or other content in a space, there is a form of viewing in which the viewer enters the projection space and is bathed in the projector's light. This type of viewing gives the viewer a sense of being one with the art and the space and may improve the quality of the viewing experience.

The purpose of this research was to confirm this by a psychological experiment. A short-throw projector was installed in our laboratory, and an environment was constructed in which art images were projected from the projector to the floor. Using this experimental environment, we conducted a psychological experiment to compare three types of viewing methods: sitting on a chair outside the projection space (Out/Chair), sitting on a chair inside the projection space (In/Chair), and sitting on the floor inside the projection space (In/Floor).

As a result, "In/Chair" received a higher evaluation result than the other conditions for the Relaxation factor, and the effect of entering the projection space to view the images was partially confirmed. At the same time, however, the results for the "In/Floor" condition were lower than those for the "In/Chair" condition. As discussed in 4.3, this is likely because the young subjects are not accustomed to sitting on a floor and are uncomfortable with this condition.

In the future, we plan to analyze the results of this experiment further to clarify the effectiveness of entering the projection space to view the projector. We hope this will lead to the expansion of new areas of use for projectors.

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